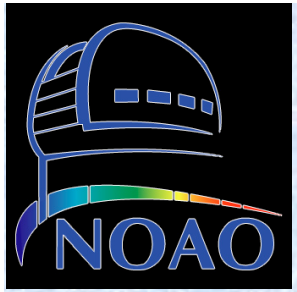

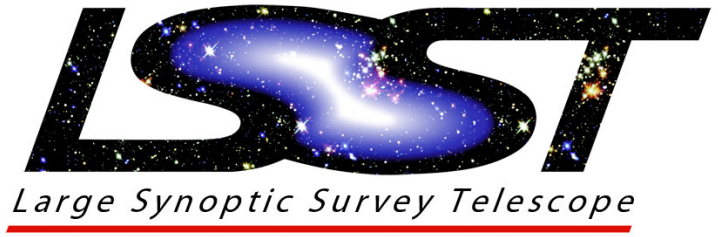

Modeling Survey Strategy – the Operations Simulator

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Dark Energy Science Collaboration
Pittsburgh, December 4-6, 2013

The Operations Simulator…..

- Generates 10-year observing programs
- Accurately models telescope design performance
- Represents weather, atmosphere and sky with models and archival data

and is used for…..

- *Telescope/survey dimensioning*
- *Site evaluation*
- Engineering tradeoffs
- Survey performance prediction
- Science optimization (survey performance & science plans)

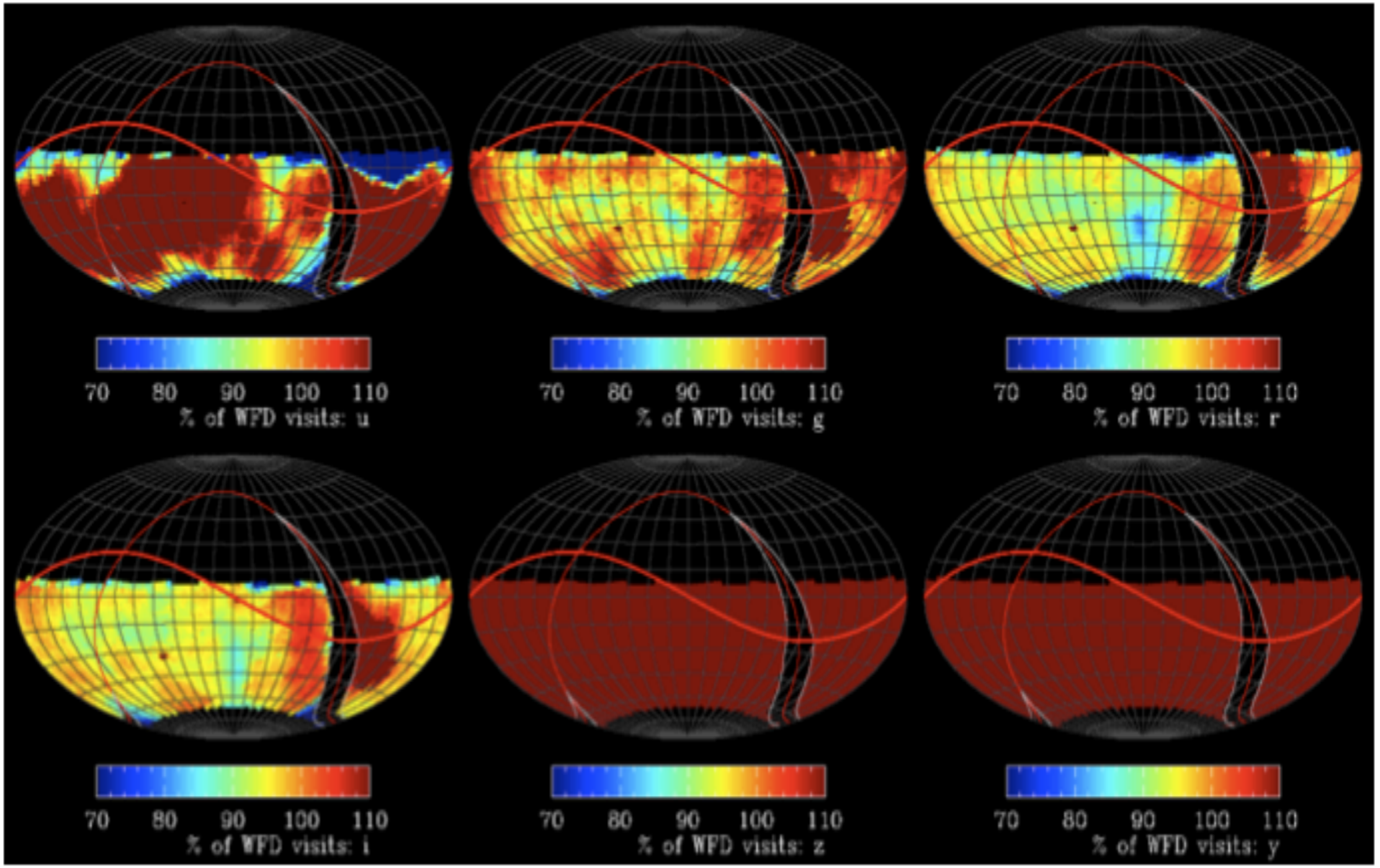
What OpSim Produces

- A chronological list of 2.4-2.6 million visits
- ~50 parameters per visit
  - Field/filter/seeing/sky-bright/cloud/airmass/etc
- Tracking of engineering data
  - Times for slew/dome/rotator/filterchange/camera-rotator
  - Contribution of engineering functions to critical path
- More than 500 survey simulations of length 3 or 10 years

Post-processing of Simulations

- Single visit and stacked visit statistics –SSTAR
  - 77% open shutter time - 96.8% of maximum theoretical efficiency
- Sky Coverage/depth Exceeds Science Requirement Document *design* specifications
  - sky coverage of 20,000 degrees^2 – 11% margin
  - 887 visits per WFD field – 8% margin
  - Median coadded depth in all fields
- But…….

Visits per Field / Required – WFD only



Merit Functions and Metrics

- Merit Functions are post-processing algorithms which characterize science-oriented and mostly cadence-related performance.
- There are currently 21 groups of Merit Functions in the areas from astrometry to uniformity.

Some lessons learned

- High efficiency can be achieved with OpSim
- Efficiency trades against uniformity
- SRD does not fully constrain cadence – there is considerable room for trading science performance and efficiency
- Strong optimization for Asteroid/NEO science does not compromise other SRD priorities
- Performance for sampling of periodic variables and slow transients is excellent
- Rapid and multi-color sampling of fast transients is achieved with dedicated cadence (deep drilling)

On-going OpSim Development

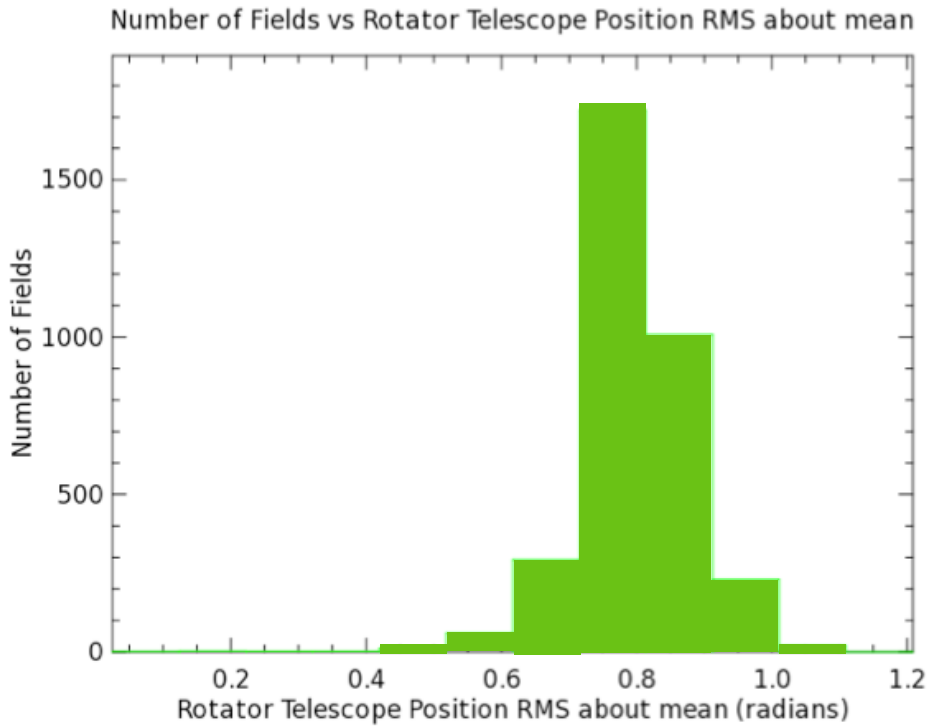
- OpSim 3.0
  - Look ahead
  - Complex sequences
  - Algorithm experimentation
- Other simulation improvements
  - Sky brightness and cloud models
- Metric Development and Post-processing framework
  - Insight into schedule performance
  - Broader access

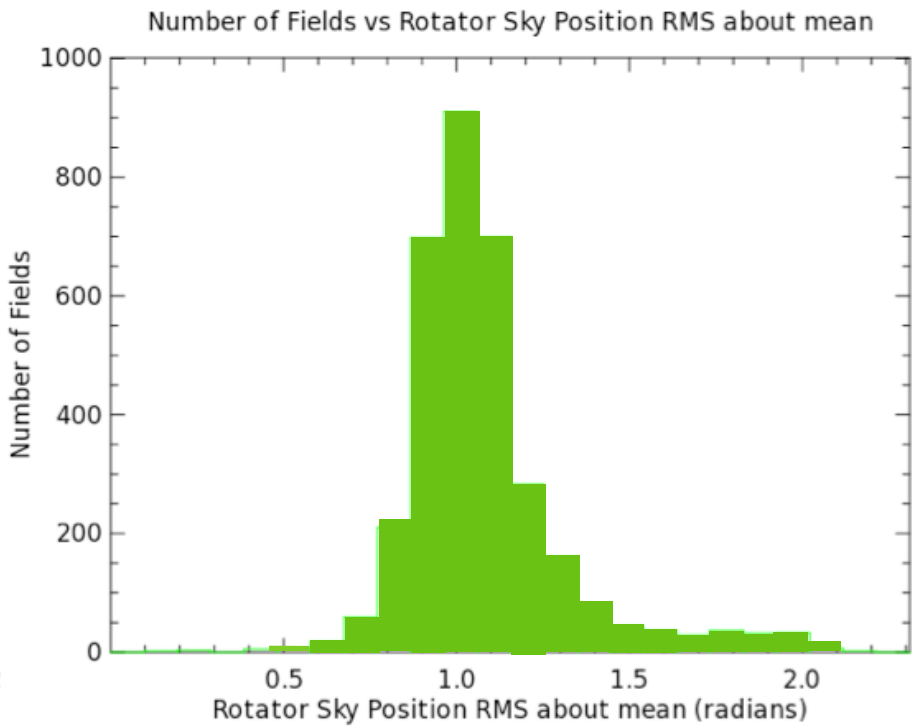
OpSim Challenges

- Scheduling algorithms and optimization
- Expert contribution to metrics specification and development

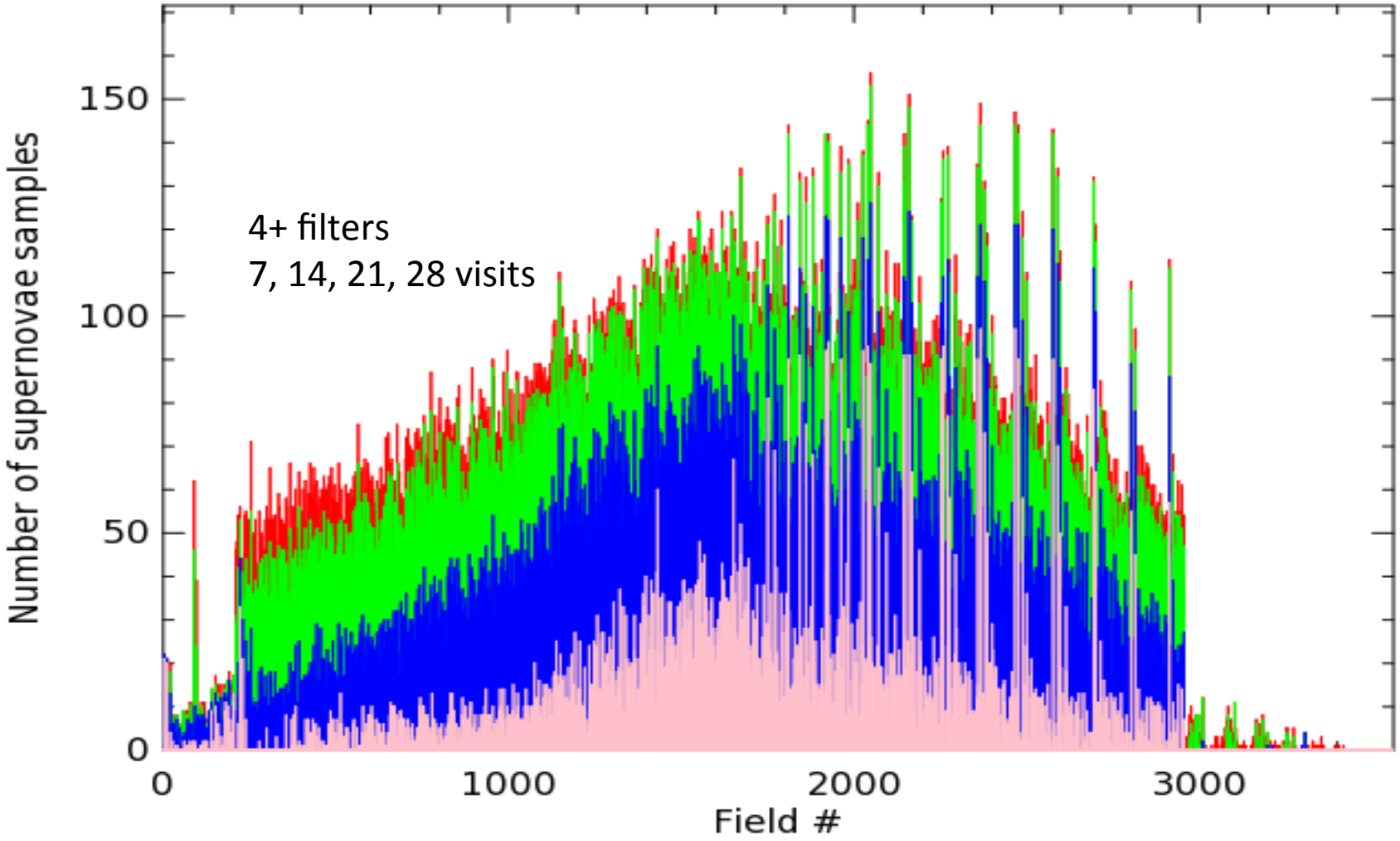
Rotator Angles

In order to control image shape systematics, it is important that the azimuthal angles of the camera and telescope optics, projected on the sky, should be well randomized. The figures below show that most fields have RMS rotator values near 1 radian (random) and very few have low RMS. Techniques are available for further improving randomization if needed.





Supernovae Discovery and Sampling



Seasonal Sampling Gaps per Field